

## Safety Auditing and Assessments

Ronnie Goodin, CSP; NASA, Kennedy Space Center; Florida

Keywords: safety management, audit, assessment, contract

### Abstract

Safety professionals typically do not engage in audits and independent assessments with the vigor as do our quality brethren. Taking advantage of industry and government experience conducting value added Independent Assessments or Audits benefits a safety program. Most other organizations simply call this process "internal audits." Sources of audit training are presented and compared. A relation of logic between audit techniques and mishap investigation is discussed. An example of an audit process is offered. Shortcomings and pitfalls of auditing are covered.

### Introduction

Audit definition - A documented systematic, independent, official, examination and verification of: records and other objective evidence of work performed; the process; or the process requirements to determine compliance to requirements; and to assess the effectiveness of implementation and identify potential improvements. This definition however may fall short of meeting objectives of the internal audit as discussed later in this paper.

Auditing is one method for evaluating a design or process to ensure safety requirements are met. Auditing also offers a tried and proven means to improve the safety process. However, as with any tool or process, auditing has limitations and there is the risk of tool misuse. This paper suggest suitable applications for auditing, outlines training options for different classes of auditing and discusses risks associated with abuse of the audit tool. A general audit model is illustrated in Figure 1. An audit process used by NASA at the Kennedy Space Center is at Attachment 1 to this paper. Specific instruction for an audit process is out of scope.

### Auditing Practice

The auditor has three customers: (1) The company, (2) The auditee, and (3) The audit program manager. A balancing effort is common place because only rarely are the needs of the three customers congruent.

Two classes of audits: (1) The traditional audit compares known requirements against evidence that requirements are met; and (2) Internal audits critically evaluate a business process searching for process improvements. Traditional audits are specific and are normally performed by personnel with auditing in their job description, while internal auditors are often subject matter experts who may or may not have had audit training and are on a team led or facilitated by a professional auditor. The internal audit is less specific than the traditional audit. The audit definition above, originating from the quality program, falls short of meeting the intent or scope of the internal audit.

Audits typically take one of two forms: (a) Scheduled audits which are somewhat routine, and as the name implies, are audits that are scheduled throughout a specific time period. (b) The second type of audit is an evaluation that responds to a real-time problem – similar as a response to a mishap.

Historically, safety professionals have used both forms of audits. The question is – can safety audits produce more meaningful information? Or more consistent information assuming consistency is important? And more trendable data?

Safety Programs claim to use the audit, but when I supervised an office of both quality specialists and safety specialists, both conducting audits and producing audit reports, only then did I realize that the quality specialists out-performed the safety specialists in the audit arena. Fundamental talent assumed equal

between the two fields, training and experience accounted for part of the differing results between the two. The better thought out quality logic contributed as well.

## **General Auditing Model**

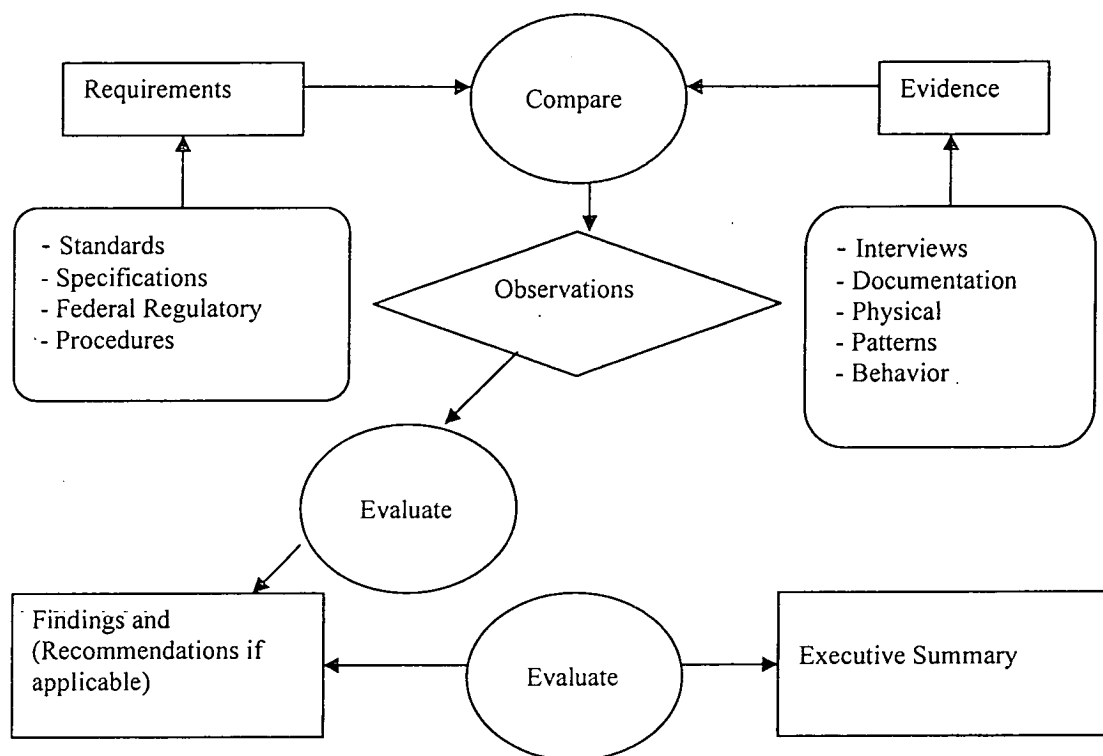


Figure 1- Typical Audit Model

Review of the Quality Program implementation of audits provides useful insights. First, the Quality Program views the audit process at different levels. The Quality Specialist conducts audits that determine if requirements are met – no more and no less. Typically these first level audits are performed against a checklist composed of all requirements of interest. These checklists insure audit scope is maintained and consistency among different auditors assured. When the level one audit by the quality specialist is complete, a second audit can be scheduled to validate a process. This level two audit is also performed against a checklist. Quality Engineering, who manages requirements, have the option to conduct audits to determine value added of existing requirements or if new processes reflect new requirements which represents a middle ground between the classic traditional audit and the internal audit that is practiced by many of today's corporations.

### Metrics

Metrics are useful if progress is to be measured. One process to evaluate the contractor safety profile at NASA's Kennedy Space Center (KSC) is presented at the 2nd attachment. One good attribute of the KSC process is that it incorporates a binary metric which saves time by reducing unproductive discussion or

debate related to the subjective metric that the contractor is assigned for a given rating period. An interesting logic of this process that has been used at KSC is that each attribute has a favored position in the center of a balancing act where at each side of center is an undesired position that is equal and opposite, resembling a physics vector.

### Training and Examples

NASA's Space Shuttle contractor, the United Space Alliance (USA), at the Kennedy Space Center (KSC) recently, on its own internal initiative, developed a process for self-evaluation or self-improvement. The contractor attacked this challenge with vigor - pooling some of its best employees who could provide useful consulting. Finally, the contractor provided both training and teambuilding to prepare this team for its challenge. The contractor completed several "internal audits" and the interim results were excellent. One novel idea woven into their process is to define at least one role player on an audit team: the role of the "devil's advocate". This role is to question everything and because its defined as a role, debates are depersonalized and become more constructive. This Devil's advocate role also serves to reduce the possibilities that the audit group will develop undesired tendency for groupthink as reported in research by Irving Janis in his book, Groupthink. (Ref. 3) "Groupthink refers to a deterioration of mental efficiency, reality testing, and a moral judgment that results from in-group pressures." Janis list 7 decision making defects resulting from groupthink. For example, Janis states, "Seventh, the members spend little time deliberating about how the chosen policy might be hindered by bureaucratic inertia, sabotaged by political opponents, or temporarily derailed by the common accident that happen to the best of well-laid plans. Consequently, they fail to work out contingency plans to cope with foreseeable setbacks that could endanger the overall success of the chosen course of action." - a non-obvious risk easily overlooked by the audit team.

One government organization with experience and recognition for doing internal audits well is Sandia. Southwest Airlines is one commercial entity with a strong internal audit group according to Institute of Internal Audits.

Audit Training Resources: A training class recommended by the American Society for Quality (ASQ) titled "Quality Audits for Improved Performance" (Ref. 4) was very good. It was taught by Dennis R. Arter. KSC scheduled this class for Shuttle safety personnel and process analysts. The audit company is Columbia Audit.

NASA Headquarters contracted with the Institute of Internal Auditors to present an "Operational Audit" class (or internal audit training) to KSC as test training. All NASA Centers were invited to evaluate the training. If such training is useful to your organization, the point of contact in the Institute of Internal Auditors' company is Denise Johnson (407-937-1337).

The ISO 9000 Lead Investigator training, in my opinion, provided little broad based skill or logic that safety personnel could apply to conducting its audits.

At the conclusion of these two different types of audit training (traditional auditing vs. internal auditing), civil servant personnel and contractor personnel who attended both classes compared the two. A summary of our brainstorming session, Figure 2, identifies desired attributes of the audit training and compares the two recent and different training classes. From this government-contractor team's point of view, if one attribute is favored, it is marked by a "+".

### Correlation Between Mishap Investigation Logic and Audit Logic

At the International System Safety Conference 2003, a relation of logic between internal audits (operational audits) & mishap investigations became apparent. During one of the presentations on mishap investigation, subsequent questions and dialogue identified a Canadian company who (a few years past) asked if it were feasible if mishap investigation training/techniques could be used for conducting internal audits. This company planned an internal audit process founded on mishap investigation training. The kinship between audit training and mishap investigation training became apparent.

Mishap investigations typically contain well thought out analyses and conclusions. However, more often than not, the recommendations have less depth and justification, and seem just stuck on as an afterthought. By comparison, internal audit teams' recommendations are table topped by both the audit team and a group of independent advocates to insure good recommendations are listed. If good recommendations were not generated, then no recommendations are included. Recommendations obvious to everybody only serve to dilute innovative recommendations - the crown jewels of the internal audit effort. More likely, the better recommendations come from the organization being audited who are addressing/responding to the concerns of the auditors.

Institute of Internal Auditors	Attribute	Columbia Audit (D. Arter) [Traditional audit logic]
Likely a product of several experienced individuals which is good	Training Class Organization	+ Highly structured, but likely a product of one individual.
High level – Deciding what to audit. Need instruction on how to audit.	Audit Process	Nuts & bolts – how to audit
+ Risk Based	Decision	Not applicable
Planning projected as 50-70% of audit and relates to defining scope and emphasizing communication with management	Communication	Planning projected as 25% of audit & relates to research of requirements and flowcharting  How to write findings - good
Soft controls emphasized	Control (formal vs informal)	Soft controls addressed but not emphasized
Unstructured. Dependent on experience of instructor. Examples were compliance type from finance world. Real engineering examples needed.	Examples	+ Structured & realistic with role playing.
Internal audits should have recommendations	Recommendations	Rare
Too much time at beginning of class with introductions.	Notes	Excellent very focused instructor with a highly organized case study used to tie the course concepts together

Figure 2 – Audit Approach Comparison

#### Audit Program Risks and Shortcomings

The traditional audit is based on the false premise that the founding fathers of the system or process were all knowing and generated perfect timeless requirements. Audits performed against requirements are self limiting and therefore can not lead to system or process improvement or leads to process improvements only with great difficulty. These traditional or compliance audits do not challenge the continued validity of the requirements – representing a rut or paradigms where many organizations fall into obsolesce. An auditor frequently using words such as nonconformance, discrepancy, problem resolution implies a traditional or compliance audit it being performed and not an internal audit.

Audit program risks are reduced when the audit is conducted avoiding various traps:

- Emotional words and phrases
- Bias and slanted viewpoints
- Insignificant issues
- More than six findings
- Poor interview technique

Management Concepts Incorporated provides training in contracting. The class handout page 4-17 (ref. 1) offered this advice, "Further, agencies must, to the maximum extent practicable, avoid relying on cumbersome and intrusive process-oriented inspection and oversight programs to assess contractor performance." Management Concepts Incorporated addressed unreasonable interference with contractor's work on page 13-4. "Although the government has broad rights in the inspection process, it has been held liable if it exercises these rights in a manner that unreasonably interferes with the performance of the work by the contractor or that increases the amount of work required of the contractor. There have been a number of cases where the government has been held liable for unreasonable interference, such as:

- Inconsistent, multiple inspections [or audits];
- Extremely rigid, unreasonable, and arbitrary conduct of the Contract Officer Representative (COR) [a COR could be a safety representative];
- Overzealous supervision of work by the COR;
- Confusing and vacillating inspection [or audits] procedures;
- Multiple inspections [or audits] to differing standards by different CORs; and
- Overly close surveillance, inordinate number of visits by CORs, and failure to cooperate in providing inspection when needed.

In these cases the contractor claimed breach of the implied duty of cooperation and was awarded damages by the court."

The process for handling the Independent Assessment Report is critical to the success of the program. In "The Essential Drucker", (ref. 2) pages 120-122 from the section on Self-control through Measurements, Peter Drucker states, "That information can be effectively used for self-control is shown by the example of General Electric. General Electric has a special control service - the traveling auditors. The auditors study every one of the managerial units of the company thoroughly at least once a year. But their report goes to the manager of the unit studied. There can be little doubt that the feeling of confidence and trust in the company that even casual contact with General Electric managers reveals is directly traceable to this practice of using information for self-control rather than for control from above. But the General Electric practice is by no means common or generally understood. Typical management thinking is much closer to the practice exemplified by a large chemical company. In this company a control section audits every one of the managerial units of the company. The results of the audits do not go, however, to the managers audited. They go only to the president, who then calls in the managers to confront them with the audit of their operations. What this has done to morale is shown in the nickname the company's managers have given the control section: 'the president's Gestapo.'"

#### Summary

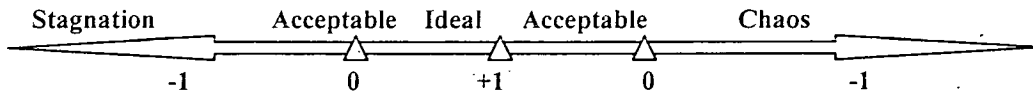
Audits can be a useful safety tool if complemented with appropriate training, thoroughly planned, with a disciplined scope, and executed with sound judgment of mind. But then the same can be said of all safety tools and processes. Good luck with your audit.

## CONTRACTOR SAFETY PROFILE

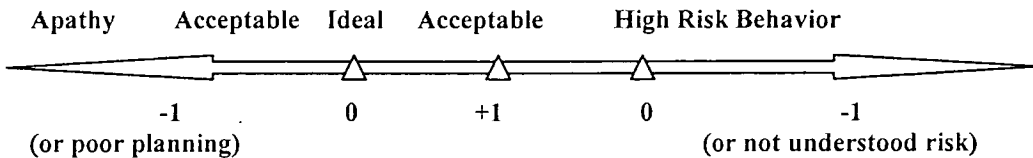
OBJECTIVE: Document Contractor safety profile.

Two scales are used to estimate or define Contractor safety profile: (1) Contractor Processes (2) Contractor employee behavior. Each of these scales is composed of several attributes.

### Contractor Process or Change Scale



### Contractor Employee Behavioral Scale



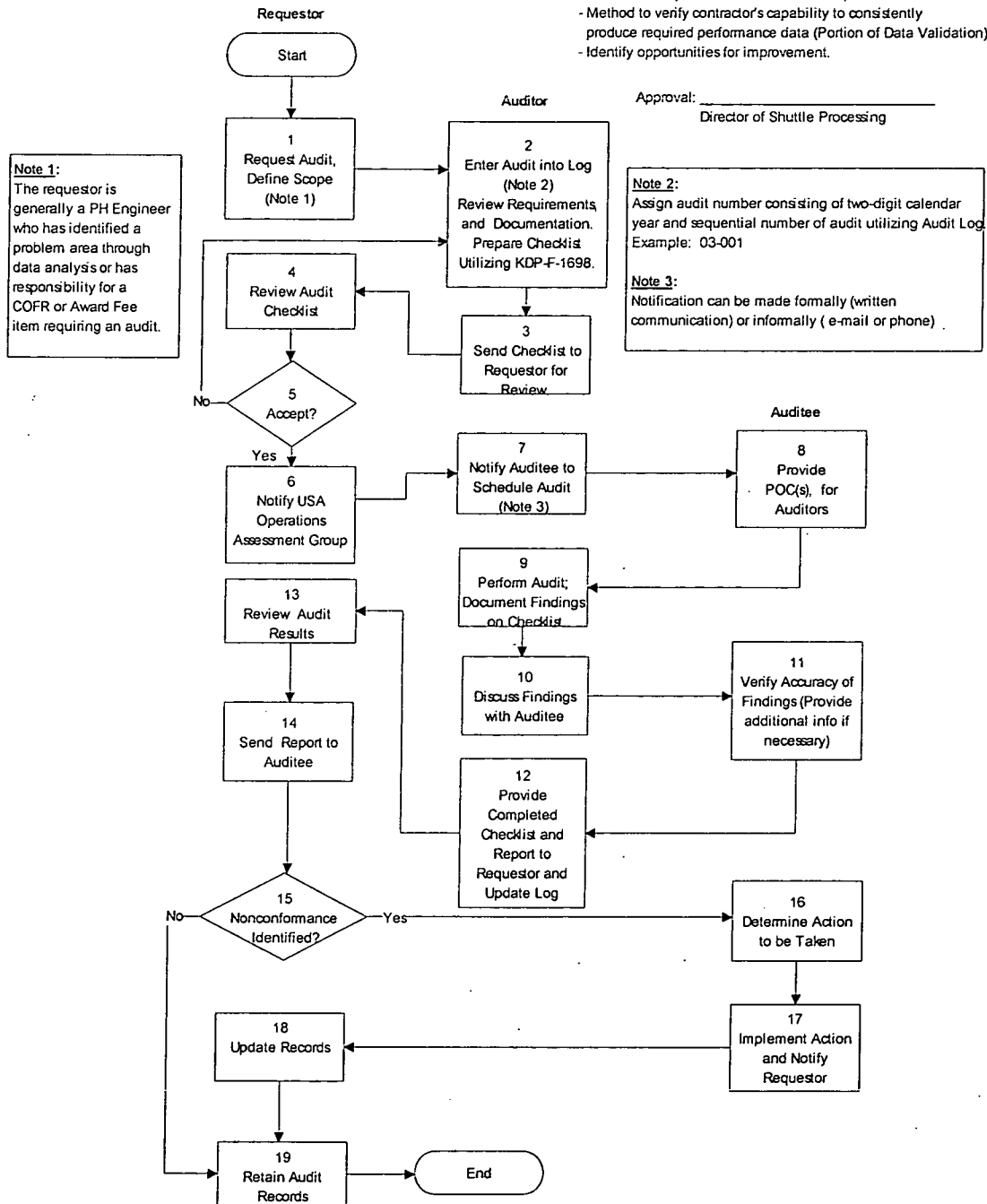
REQ.	ATTRIBUTES	CONTRACTOR ACTIVITY	Grade
	Management & Employment Commitment (Element 1) Reporting of safety concerns implies ideal behavior. Healthy volume of reporting ideal. Non reporting implies apathy.		
	Management & Employment Commitment (Element 1) Communication. Active discussion of safety risks implies the ideal.		
	Management & Employment Commitment (Element 1) Employee discipline is ideal. Respect for hazardous operations control areas is ideal where disregard for control areas is high risk behavior.		
	Management & Employment Commitment (Element 1) Requirements management. Excessive number of safety variances imply poor planning. However, safety variances resulting from conscious choices where documentation resulted in no change in risks are acceptable; and safety variances to rigid rules where innovation developed a safety method with less risk than residual risk associated with the rule is commendable.		
	Worksite System & Analysis (Element 2) & Hazard Prevention & Control (Element 3)		

	Documentation of risks. Risk assessments. Example: safety variances. Project Risk Review Board. or close call risk assessments.		
	Hazard Prevention & Control (Element 3) Corrective actions.		
	Hazard Prevention & Control (Element 3) Contractor mishap rate as compared to like industry mishap rate. Contractor forms mishap investigation boards more often than when required by NASA.		
	Hazard Prevention & Control (Element 3) Violation of safety requirements. Violation of safety requirements is either poor planning or high risk behavior. Example of an operations violation is disregard for safety control during hazardous operations.		
	Safety & Health Training (Element 4). Adequate employee qualifications insures recognition and understanding of safety risks. See safety employee qualifications at time of hiring, and review all employee training records. Certified Safety Professional (CSP) registration or PE registration, annual safety training courses and VPP certification are examples of qualified and or a safety motivated work force.		
	Potential personnel actions. Company growth is ideal while potential layoffs results in high risk behavior or chaos.		
	Contractor process change. Shuttle is a mature and stable system with little uncertainty. Expect no revolutionary change, only expect methodical Demming type changes. Healthy processes should be constantly reevaluated. (a) Quality inspections where there are no changes imply stagnation and huge changes to quality inspections imply chaos. (b) Active Contractor Corrective Actions imply the "ideal" (c) Contractor innovation affecting safety is ideal.		

## AUDIT PROCESS

### Objectives

- Provide a method to efficiently perform contractor audits for compliance to documented requirements.
- Method to verify contractor's capability to consistently produce required performance data (Portion of Data Validation).
- Identify opportunities for improvement.





### References

1. Contracting Officer's Representative Course, Management Concepts, 2004.
2. Drucker, Peter, The Essential Drucker, Harper Business Press, pages 120-122.
3. Janis, Irving, Groupthink, Houghton Mifflin Company, pages 9-10.
4. "Quality Audits for Improved Performance", Columbia Audit, 6951 W Grandridge, Kennewick, WA 99336, 509/783-0377, toll-free 877/597-9498, arter@quality.org, <http://www.quality.org/arter>

### Biography

James Ronald (Ronnie) Goodin, CSP., Safety, SAF, Kennedy Space Center, FL 32899, USA, telephone - (321) 861-4131, email - ronald.goodin-1@nasa.gov.

Ronnie Goodin has 30 years of system safety and industrial safety engineering experience with both DOD and NASA.

BS Aerospace Engineering from Mississippi State University  
Graduate from the Army DARCOM Safety Intern Center

10 years in system safety with the Department of the Army; time split between the Army Aviation Command and the Army Safety Center

20 years with NASA,

NASA HQ: 1 year

KSC: 3 years in payloads (operations)

9 years in payload system safety

2 year in the Industrial Safety Engineering Branch

4 years in Shuttle Program Safety

1 year safety support of Engineering Development (Current)